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ABSTRACT
                  A classification of remote sensing courses throughout
the world, the world-wide need for sensing instruction, and
alternative instructional methods for meeting those needs are
discussed. Remote sensing involves aerial photointerpretation or the
use of satellite and other non-photographic imagery; its focus is to
interpret what is in the photograph or image. Remote sensing courses
are classified into four models on the basis of the strength or
weakness of the education and training components of each course. The
first model is exemplified by high quality, graduate level programs
in which relatively few photographs and images are studied, with a
quantitative and specific discipline emphasis aimed at minimizing the
need for expensive field work. The second model involves a strong
education component with weak training; students usually study a wide
variety of images illustrating diverse topics. The third model, most
often used in internal courses of defense organizations, rates low in
educational aspects but strong in training. The fourth model, weak in
both education and training, is common in small schools and less
developed countries. Recommendations are for strengthening the system
of lectures and practical classes through short courses, seminars,
workshops, and nontraditional methods. A course in the distance
education program at the University of Brasilia (Brazil) is
described. (Author/KC)

INTERNATIONAL MODELS AND METHODS OF REMOTE SENSING EDUCATION AND TRAINING

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ABSTRACT

The great variety of remote sensing courses (for both photographic and other imagery) are classified into four principal models on the basis of the strength or weakness of the education and training components of each course. The first model, strong in both education and training, is exemplified by high quality, graduate-level institute programs such as the ITC courses in the Netherlands. Relatively few photographs and images are studied, but they are examined in greater detail, with a "quantitative" and "specific discipline" emphasis aimed at minimizing the need for expensive field work. Plenty of time is allowed for training in the technical aspects of remote sensing. The second model is "generalized" and "qualitative", and is typically found in undergraduate American colleges and universities. Although the education component is strong, the training is weak; students usually study a wide variety of images illustrating diverse topics. Apart from the internal courses in some defense organizations, there is very little work done within the third model, which is intentionally "low-level" in the educational aspects but strong in the training of techniques. The fourth model, weak in both education and training, is common in small schools and Less Developed Countries deficient in trained professors, textbooks and other resources. The world-wide need for better, more accessible quality education and training is alarming, and a call is made for the use of non-traditional education. Such a course in Brazil, by this author, is discussed.

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I. INTRODUCTION

Literally thousands of remote sensing courses are offered each year around
the world. The subject matter is fairly well-defined, mainly being aerial
photointerpretation or the use of satellite and other non-photographic imagery.
However, there are fundamental differences in emphasis and quality of the
education and training components. This paper deals with a simple classification
of those courses, the world-wide need for remote sensing instruction, and
the alternative instructional methods for meeting those needs.

II. TERMINOLOGY

In order to focus this discussion about remote sensing education and
training, a few terms should be clarified. These are not definitions,
nor are they proposed for usage outside the discussion of this paper.

Remote sensing is "in the broadest sense the measurement of acquisition
of information of some property of an object or phenomenon, by a recording
device that is not in physical or intimate contact with the object or
phenomenon under study" (Reeves, 1975, p. 2102). Therefore, it includes
aerial photographs used in photointerpretation and also non-photographic imagery
used in image interpretation (non-photographic). This separates the two major
parts of remote sensing. Remote sensing is primarily interested in interpreting
"WHAT" is in the photograph or image. The precise locating of "WHERE" the
object is pertains more to the realm of geodesy, surveying, and photogrammetric
plotting (using large, precise instruments), topics which are not included in

this paper. However, <u>photogrammetry</u> is of interest to the extent to which the internal and relative measurements of the remotely sensed objects or phenomenon can be determined.

There is an essential distinction between <u>education</u> and <u>training</u>, as stated by d'Audretsch et al. (1981, p. 172):

> The objectives of <u>education</u> are to bring the individual to an understanding of a subject so that he or she may form independent opinions, establish priorities, understand and discuss the methodology, the techniques used and their application.

Education does not necessarily result in the ability to use the techniques.

> The objectives of <u>training</u> are to teach individuals to carry out specific tasks based on an accepted methodology and for which known techniques are available. Understanding of the context . . .. [and] knowledge of the subject as a whole . . . [are] not always required; often only the ability to apply the technique is needed.

The distinction between education and training is shown in the following pairs of questions which reveal the separate and combined advantages of education and training:

1. a. Explan how radial displacement can be used to measure heights in stereographic pairs of vertical photographs.

1. b. Using a stereomicrometer (parallax bar), measure the height of thirty trees, having confidence in your ability to consistently measure parallax differences within a predetermined level of precision.

2. a. Explain how different "bands" in the electromagnetic spectrum produce different graytones for the same object.

2. b. Using a densitometer or a gray scale, compare the four-band signature of one known corn field with the signature of twenty selected locations on the Landsat image.

Instruction denotes the combination of education and training. The terms "instruction," "education," and "training" are used in their broad sense to include both teaching and learning, but they are subdivided by academic levels: doctoral, master's, undergraduate, and technical. The need for secondary and primary education in remote sensing and cartography will be left for another article.

III. MODELS

It is hard to model existing education and training programs without offending someone who feels misclassified. Therefore, please note that there are numerous exceptions and that the author does not have personal, first-hand knowledge about many institutes, universities and centers which are involved in remote sensing education and training. Also, the models are intentionally simple, using only two variables, "education" and "training," each divided into "high" and "low". The result is four models: (1) high-high (2) high-low; (3) low-high; and (4) low-low (See Figure 1). Surely there must be some high-moderate schools, many moderate-moderate universities, and so on. But such "detailed" classification starts to encourage quantitative comparisons and "grading," which is not an objective of this paper.

High-high: High in education and high in training (Model "I"):

This is called Model I (letter "eye", not number "one") in recognition of the strong combination of education and training at specialized institutes. An example is the Internatinal Institute for Aerial Survey and Earth Sciences (ITC) in Enschede, The Netherlands, a world leader in remote sensing education and training. Its chief sponser, the Dutch Government, has also established three "daughter institutes" in cooperation with the governments of India, Nigeria and Colombia. Other institutes which join this prestigious group
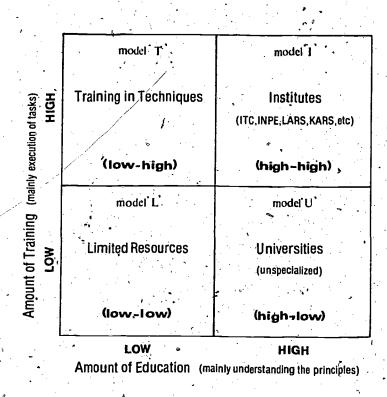
	model T	model I
HIGH	Training in Techniques	Institutes
		(ITC,INPE,LARS,KARS,etc)
	(low-high)	(high-high)
LOW	model L	model U
	Limited Resources	Universities
		(unspecialized)
	(low-low)	(high-low)

Amount of Training (mainly execution of tasks)

LOW   HIGH

Amount of Education (mainly understanding the principles)

Figure 1. Relationship of four basic models
for teaching remote sensing

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include INPE (Instituto de Pesquisas Espaciais) in Brazil, and Purdue University
(USA) with its LARS program. Others could be included, and each has its
specialty which distinguishes it within the high-level education/high-level
training model. Nevertheless, there do seem to be several underlying
similarities:

a. almost exclusive focus on remote sensing;

b. graduate-level education directed toward the specific professional
   discipline of the student;

c. "critical mass" of well-qualified professors, able to attract top
   students plus outside funding for scholarships, research projects,
   and equipment;

d. adequate time allowed for training in remote sensing techniques;

e. relatively high expenditures per student;

f. relatively few students;

g. attention to quantification and measurement, trying to get the most
   from the photograph or image in order to reduce to a minimum the
   expensive fieldwork. Thus it is a "specialized" and "quantitative"
   model of instruction, studying in depth relatively few images and
   photographs.

These high-high schools could offer first-rate undergraduate education or
technical training programs, but most do not or limit their enrollments. The
general rationale is that image interpretation and even photointerpretation is
best done by professionals trained in their specific disciplines (Vink, 1964,
p. 14; Lillesand, 1982, p. 290). In principle, almost everyone agrees; but in
practice, there are not enough people who are strong in their professions and
also strong in remote sensing, in both education and training. Furthermore, by

choice or financial enticement, these top people frequently find their way into positions of "pure" research and development, grant-hunting and administration, progressively further and further removed from the more mundane but extremely necessary tasks of professional interpretation.

There is also a double-edged danger within remote sensing instruction: too much vs. too little specialization. For example, a master's degree student might write his thesis on "thermal image diurnal radiant temperature variations of selected land uses," but he may never become proficient in handling other imagery or photographs. In contrast, training which tries to uniformly cover all of the sensors risks the danger of leaving the student without sufficient competence with any of the remote sensors. Finding a balance between the extremes is a continuous task for each school and each student.

<u>Low-Low: Low in education and low in training (Model "L"):</u>

Model L stands for "Limited Resources", and it applies equally to the education/training in Less Developed Countries (LDC's) and to less-developed courses (Tower case l.d.c.'s). There is a great deal of this throughout the world. Model L situations are noted by their lack of financial and physical resources; some schools in the LDC's or with l.d.c's have only one mirror stereoscope, maybe with a broken parallax bar. Usually the professor lacks instruction or even the desire to teach remote sensing. And in many languages there is no readily available textbook. If much of anything is taught, it is probably aerial photointerpretation (rightly so, because satellite images are considerably less useful or less available in such precarious situations). That photointerpretation is usually descriptive and idiographic, looking one day at river meanders and the next at volcanos. (This is in part a result of photointerpretation courses being taught by geography professors.) In

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such cases the interpretations can provide a useful, in fact a very useful .

supplement to a geomorphology or biogeography course. But it is hardly the

basis for someone's employment in remote sensing. As such, this low-level

education and low-level training serves mainly as a general instruction course.

(The student finds out that maps are made from aerial photographs, and maybe

he will see an off-set print of a satellite image.)

A sub-type of the Low-Low model is the No-No model: No education and no

training. It frequently occurs in the Less Developed Countries that university

students graduate in geography, geology, agronomy, forestry, civil engineering,

ecology, etc., without ever studying or even having the chance to study a course

in photointerpretation. This lamentable situation is not anyone's fault; it is

mainly an unfortunate fact which stems from lack of national development.

However, it is rather astonishing that nearly half of the 43 accredited

forestry schools in the United States do not require even two quarter-credits

of aerial photointerpretation. (Lillesand, 1982; p. 290). Perhaps those

schools offer excellent courses, but they do not require their students to

take them.

High-Low: High in education and low in training, (Model "U"):

The letter "U" stands for "Usual" and "University," referring to most

universities and colleges in North America, Europe, and other developed areas.

Model U courses have strong lecture programs providing the theory and

explaining the uses and applications. They area given by qualified

professors who use good textbooks. However, the laboratory/practical classes

tend to be weak for any of a variety of reasons:

  a. lack of equipment, photographs, etc.;

  b. lack of time; too few credit hours to permit true training;

c. too much ambition: the professor tries to show everything, resulting in isolated learninig experiences with insufficient re-enforcement to gain command of the techniques. In other words, the technological issues overpower the technical training.

d. preoccupation with the glamour of fancy images, resulting in neglect of the basic handling of aerial photographs;

e. outright rejection of the idea that training can be part of a university degree;

f. emphasis on the content of the photographs and images (e.g., rivers, relief, urbanization, land use, etc.) instead of on the characteristics of the photographs and images (e.g. flight line, parallax, side-lap, focal length, scale, etc.)

g. over-extension of one or two courses trying to serve a wide combination of disciplinary interests: geography, geology, ecology, etc,

These are all formidable and defendable reasons why the training is weak. The approach is primarily "generalized" and "qualitative," examining the question of "what" but often neglecting the questions of "how much": how deep? how high? how wide? how many?

The principal English-language textbooks support the qualitative approach. Although of varying quality and levels of difficulty, the textbooks traditionally have introductory chapters on cameras, parallax, and some basics of the electro-magnetic spectrum. Following that, some have a mainly "discipline oriented" approach exemplified by Avery's book (Interpretation of Aerial Photographs, 1977) and the text edited by Richason (Introduction to Remote Sensing of the Environment, 1978 and 1982). The first Manual of Photographic Interpretation (American Society of Photogrammetry, 1960) was of this type. Other authors such as Sabins (Remote Sensing: Principles and Interpretation, 1978) and

Lillesand & Kiefer (Remote·Sensing and Image Interpretation, 1979) adopt a "sensor-oriented" approach. The massive Manual of Remote Sensing (American Society of Photogrammetry, 1975) is sensor-oriented in the first volume and discipline-oriented in the second. These books are clearly for education and not for training.

Standberg's Aerial Discovery Manual, (1967) offers some training through its "work-study" sections and has aerial photographs (off-set prints) on large pages which can be cut from the book without affecting the text. Apart from basic concepts and photo manipulation, that book concentrates on photogeology and photohydrology. The Laboratory Manual for Introduction to Remote Sensing of the Environment, edited by Richarson (1978), offers a wide selection of images but seems to be aimed more at a visual tour of the sensors and their applications, and less at training, thus matching the courses in the Model U. Since the title clearly states that it is introductory, no student should feel misled. However, the need still remains for a manual with a training emphasis.

In the Portuguese·language, the selection of textbooks is severely limited. Many schools use mimeographed notes from the professor or the more refined and published class-notes of Marchetti and Garcia (Principios de Fotogrametria e Fotointerpretacao, 1977). The excellent photogeology book by Ricci and Petri (Principios de Aerofotogrametria e Interpretacao Geologica, 1965) has been out of print for several years. Its exervises were strictly geological interpretations. One other book in Portuguese is by this author (Anderson (ed), Fundamentos para Fotointerpretação, 1982). It focuses on the fundamental concepts of photointerpretation and the relevant photogrammetry.

Two chapters are translations from ITC publications. The book is small (120 pages of text and figures), being the first of a series of volumes. Perhaps more important than the textbook is the Study-Guide with Exercises. If studied quickly, it is general and educational. If examined in depth, it attempts to provide the start of solid training. The use of an earlier version of this guide book by four groups of students will be discussed later.

Low-High: Low in education and high in training (Model "T"):

Model "T" means Training in Techniques. In a recent study of the "Status and Content of Remote Sensing Education [and training] in the United States", Dalhberg and Jensen (1981; see Lillesand, 1982, p. 289) report:

> One of the most glaring gaps is the near absence of remote sensing technician training programs in American colleges. Such programs exist within the defense establishments, but elsewhere commercial firms and government agencies must rely upon on-the-job training.

Nor are many such courses found in other parts of the world.

The idea that interpretation is best done by professionals in the various disciplines works against the establishment of Model T schools. This is unfortuante for several reasons:

1. Photographs and satellite images are being generated at increasingly faster rates, considerably faster than the growth of the number of people trained to utilize them.

2. Many routine interpretations could be performed by technically trained workers, just as the defense establishments have thousands of interpreters working under the supervision of the professionals. Such interpreters would not be ignorant of the issues being studied, nor would they need a master's or even a bachelor's degree before they could make useful contributions.

3. Time lags could be shortened. For example, thousands of aerial
    photographs of Brazil taken in the mid-1960s area only now being
    utilized for thematic mapping of forests, soils, geomorphology,
    geology, etc. Meanwhile, the newer images are often used for
    only a single purpose.

4. Less money would be spent per image analyzed.

5. Technical abilities need to be offered to the thousands of
    qualified professionals who are in the field but are not trained
    to use remote sensing to the fullest, applied extent.

In various ways, training is a prerequisite for application. The
more education a photointerpreter has, the better he can utilitze his training.
But without training, even a person with education is far from doing "applied"
work.

The four models discussed above are derived from a two-variable
dichotomous classification based on the high or low levels in education and
also in training for remote sensing. Such a simple classification leaves
many doubts about the borderline schools. To further divide and to eventually
quantify the classification, the following factors could be considered (all
in relation to education and separately in relation to training):

1. Separate evaluations for aerial photointerpretation, for LANDSAT
    imagery and for other imagery;

2. Count the number of hours or courses of instruction available;

3. Evaluate the quality of instruction in each hour or course; and

4. Establish general criteria about what constitutes the various
    basic course components.

This would not need to be a judgmental classification but merely a

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guideline to identify the strengths and weaknesses in each program of study.
The various professional organizations (ISP, ICA, ASP, ACSM, AAG and others)
should all participate in developing general guidelines. However, the criteria
should probably never become "official" because of the need for variations
and because of the continuous and rapid changes in remote sensing technology
and applications.

IV. CURRENT SITUATION AND NEEDS

In 1981-83 at least four independent articles have been published about
the current situation and needs. Each has a different origin, data source,
and emphasis, but all four arrive at a similar conclusion: there are major
needs for expansion, up-grading, modernization, and change in education and
training for remote sensing and related fields.

Two of the articles are from the United States. Joel Morrison (1981),
in his keynote address as the President of the American Congress on Surveying
and Mapping (ACSM), said:

> The crisis of the 1980s in education is real . . . We are
> continuing to make breakthroughs in the technology used in the
> surveying and mapping professions. We cannot simply train a student
> in today's technology and expect that he or she will be employable
> for a normal working life span. Technology is changing too rapidly
> for that to happen.

The first National Conference of Remote Sensing Educators (CORSE-81)
was attended by 200 individuals in May of 1981. Lillesand's summary (1982)
contains Dahlberg and Jensen's quote about ". . . the near-absence of remote
sensing technician training programs . . ." and includes the following
observation:

> The large number of short courses in remote sensing is clear
> evidence of a strong and expanding demand for education in this
> field. It is also symptomatic of the need for more formal training
> and of serious lags in technology transfer within the system.

The two international articles reveal the much bleaker situation found

in the developing world. Brandenberger (1981) gives the results of a United Nations sponsored study of "The World's Surveying and Mapping (S&M) Manpower and Training Facilities." Photogrammetry and related fields (including remote sensing) amount to only 15 percent of the total S&M manpower world-wide, and it is easy to imagine that the proportion is even less in the developing nations, where the newness of remote sensing retards still further its incorporation into the surveying and mapping field. Furthermore, to take a specific case, South America has only one university level "surveyor/mapper" per 6,000 km^2, not taking into account the large numbers of those who are in administrative positions, retired, etc. The size of this "area to serve" is about six times greater than the one for North America, which includes the vast wilderness of northern Canada and Alaska. It is about forty times greater than the figure for Europe (excluding the USSR).

The article by d'Audretsch, Hempenius, Voute and Woldai (1981) on "Education and Training in Remote Sensing Applications" for satellite imagery is a summary of another United Nations sponsored study, and concludes:

> On the basis of independent studies and the assumptions made by the team as to the requirements for education and training, the developing countries with a current population of 3000 million will have an annual educational capacity demand for remote sensing application of approximately 18,000 man-years during the 1980s and 1990s. The present capacity available for these countries falls short of the demand by a factor 10. Therefore, the introduction of new edcuational methods directed to reach more people at the same time will be of ultimate interest.

IV. METHODS

In light of such needs for better and more education and training, what methods can help provide solutions? Various partial solutions already exist. Nowhere in this article is there any hint of abandoning the traditional

means of education. The system of lectures and practical classes provides

a backbone to the instructional methods. Perhaps some specific courses could

be improved, but the methods are approved.

> Both curricula and teaching aids must be developed, including
> modern means of learning, for various groups in society--from
> planners and managers to research workers and teachers, with
> the productive [production] personnel and the technical support
> staff in a central position. The wide spectrum of these groups
> makes it impossible to design standard curricula. These [diverse]
> groups will require different monitoring curricula. (d'Audretsch,
> et al., 1981, p. 182).

In addition, short courses, seminars and workshops offer a chance for

up-dating and refreshing. Therefore, they need to remain near or at the

frontiers of research and application. Workshops should pass along selected

topics to the traditional courses, which tend to be less expensive and which also

need to be updated. This might go against the "non-profit profit-making" of

some institutes that use short courses to supplement salaries and buy

equipment, but it will force those courses to be either updated or outdated.

The professional societies and the university boards of directors should

make efforts to release or sell copyrights to their workshop material and not

compete with the undergraduate and graduate courses.

Finally, the non-traditional methods of instruction must be brought into

action. These are mainly aimed at individualizing the instruction without

classroom attendance.

> Modern learning methods are certainly needed for the various
> groups because the present educational methods do not respond
> adequately to the demands. Programmed learning packages and 'distance-
> learning' using the new media become sheer necessities. Both also
> offer openings for new educational activities. These can include
> direct broadcasting satellite television, video-cassettes and video-
> discs, recording and play-back equipment for office and home, and
> simulation of digital image processing on personal micro-processors.
> Colour television screens and computer-displays are particularly valuable
> because colour is an essential element for the application of
> multispectral remote sensing techniques. (d'Audretsch, et al., 1981,
> p. 183).

One step towards such "individualized learning" is available from the Purdue University Division of Independent Study, which sells a "Minicourse Series" about the "Fundamentals of Remote Sensing."

Each minicourse is a self contained instructional package presenting basic concepts in remote sensing. Topics range from basic photointerpretation to numerical enhancement and pattern recognition, from sensor design to data selection . . . The series was created by an innovative team of scientists, engineers, and educators on the staff of Purdue University and the Laboratory for Applications of Remote Sensing (LARS). In 1976, 19 modules were released; in 1980 an additional six were released, two of which were co-authored by instructors at ITC (International Institue for Aerial Survey and Earth Sciences) in the Netherlands.

Both LARS and ITC have long taken leadership roles in remote sensing education. The minicourses capture the most effective instructional techniques developed through their years of teaching. The minicourses are portable; you can use them in a classroom, in a learning center, or at home — wherever there is a cassette tape player and a slide projector. Because the packages are designed for individual instruction, they have "instant replay" capabilities, so you can go back and listen again to a difficult portion of the minicourse. Each minicourse is written at the college or professional level. The slide-tape programs, with accompanying study guides, typically require from 45 to 75 minutes to complete. You control the rate and intensity of study.

When you complete the minicourse series you will be in a position to begin answering important questions about the applicability of remote sensing in your own area of interest. You will have learned concepts and gained insight into the potentials and limitations of the technology and will have glimpsed some of the most current research under way. (Purdue, 1981).

The appeal of such audio-visual material is very great. Unfortunately, the cost is US $85.00 per individual minicourse, or US $2000.000 for the entire series, rather expensive for approximately one hour (or 25 hours total) to learn concepts, gain insights, and glimpse some current research. The five (US $250.00 each) half-hour videotapes have a similar draw-back:

they are not readily accessible (financially) to the typical individual.
Furhtermore, although sequesntial, the units do not form a single, self-
contained course, and they are for education, not training.
In spite of these drawbacks, there is no doubt about the excellent quality of
the material and the advantages of using it in other universities and
colleges. Somehow, Purdue University should be compensated for its
originality so that each minicourse could be sold at a price commensurate
with its 30-40 slides, one tape cassette and 20 printed pages. The value
of such material when translated for remote sensing education in developing
nations is immense. But instead of using this material, probably a dozen
people around the world are working on something roughly similar to one or
more of the minicourses, and each will be seeking a market.

Less sophisticated individualized materials also exist. Some are
called correspondence or distance education courses. Professionally
accredited cartographic draughtmanship has been taught by correspondence
in the Netherlands since 1973 (Ormeling, 1976). In Australia, where
degree-granting distance education has been established since 1911, map
interpretation and cartography are regularly taught to students who do not
attend classes. Also, the Universidad Estatal á Distancia in Costa Rica has
an accredited course in basic cartography.

As mentioned earlier, remote sensing, (specifically photointerpretation)
has also been taught with distance education methods (Anderson, 1981). A
course entitled "Fundamentals for Photointerpretation" was offered three times
in 1979-80 in the distance education extension program of the University of
Brasilia, Brazil. Because the course was experimental, enrollments were
limited each time to twenty students in the Brasilia area. The content was
equivalent to a ten-week, 45-60 class-hours university course, but this

course had only twelve hours of class-work with four hours for examinations).
The classroom hours can be further reduced, especially since the study-
guide has been revised. The professors were also available for the individual
consultations, which were infrequently requested.

Each student purchased or received on loan the following material:

1. the mimeographed Study-guide and Exercises;

2. the mimeographed preliminary version of the textbook Fundamentos
   para Fotointerpretação;

3. the textbook by Marchetti and Garcia;

4. A pocket stereoscope;

5. a package with photographic copies of aerial photographs, tracing
   paper, marking pencil, masking tape, and other supplies;

6. a published topogrphic mapsheet (area of Brasilia at 1:100,000).

The course was essentially methodological, with both a theoretical
and practical base. It emphasizes the fundamentals of photointerpretation
applicable to various user professions. The content sequence was as follows:
introduction; basic characteristics of aerial photographs; geometry for
photointerpretation; stereo-viewing; elements of recognition; methodology
for photointerpretation; parallax; heights and the floating mark. Also
offered one time, and using a simliar methodology was the second course
in the sequence: "Techniques for Photointerpretation."

In all cases, the courses were well-received by the vast majority of
the students. Their test results were statistically the same as those of
students enrolled in a traditional university course using the same books
and professors. Although the distance education of photointerpretation at the

University of Brasilia was discontinued (unfortunately for bureaucratic and political reasons,) its viability has been demonstrated.

The advantages of distance education are numerous: outreach to the student where he lives; minimal costs to student and school; large numbers of students; quality material prepared by selected professors/writers; international comparability; flexible timetable; almost unlimited time for training, including serious and complete projects; special training centers in constant use by successive groups of students who are well-prepared when they arrive for one or two-weeks of concentrated instruction; employment for graduate students in correcting exercises and answering student inquiries; parallel courses for groups with slightly different interests or levels (managers, supervisors, interpreters, technical support staff); and ease of periodically updating former students.

In light of the ten-fold deficit in man-power training and education in the developing countries, distance education is one of the few alternative solutions that could be viable. At present, much remains to be done to implement it on any major scale, even for a single remote sensing topic.

VI. CONCLUSION

A topic such as INTERNATIONAL MODELS AND METHODS OF REMOTE SENSING EDUCATION AND TRAINING is so broad that its treatment must simultaneously be general in scope and limited in examples. This article has tried to define the terms, model the current approaches, assess the needs, and discuss the solutions. Its purpose also has been to stimulate further discussion and to prompt some action for solutions.

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